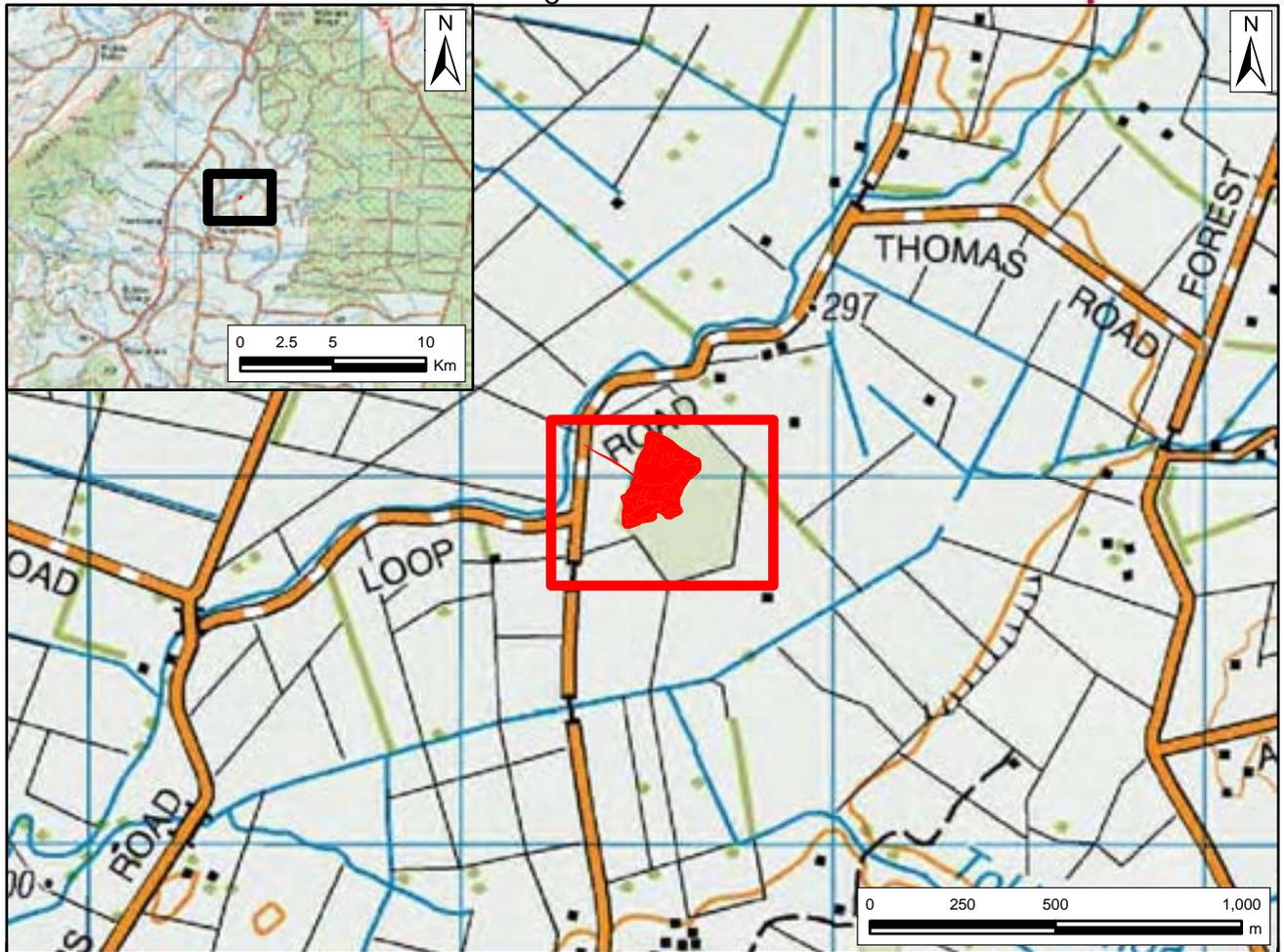


1.10 REPOROA GEOTHERMAL FIELD

List of Geothermal Sites

RPV01	Longview Road
RPV02	Wharepapa Road
RPV03	Golden Springs



LONGVIEW ROAD

Site Number: RPV01¹
Grid Reference: NZTopo50 BF37 935 430
GPS reference: NZTM E1893489 N5742976
Local Authority: Rotorua
Ecological District: Atiamuri
Geothermal Field: Reporoa
Bioclimatic Zone: Submontane
Tenure: Protected (Molloy Conservation Covenant)
Altitude: c.300 m
Extent of Geothermal Habitat: c.3.6 ha
Extent of Geothermal Vegetation: c.3.4 ha
Date of Field Survey: 27 May 2004

VEGETATION		LANDFORM	EXTENT
CODE	TYPE		
05.02 05.02.02	Mingimingi-dominant shrubland Mingimingi-manuka shrubland Mingimingi dominates the canopy (which ranges from 0.3-4 m high), with scattered manuka. Local patches of blackberry and bracken with scattered <i>Muehlenbeckia australis</i> are present, particularly in the northeast corner.	Flat	c.1.8 ha
05.03 05.03.01	Manuka-dominant shrubland Manuka shrubland A narrow band of manuka (often only c.1 m wide) occurs alongside heated creeks. Other vascular plant species present include mingimingi, blackberry, <i>Histiopteris incisa</i> , <i>Juncus effusus</i> , <i>Juncus edgariae</i> , and rank grasses (predominantly Yorkshire fog).	Flat	<0.1 ha
28.01 28.01.01	Nonvegetated raw-soilfield Nonvegetated raw-soilfield Sinter pavement, boiling water and hot springs.	Flat	c.1.5 ha
22.01 22.01.01	Geothermal water Geothermal water Hot springs, geothermal lakelets.	Flat	c.0.2 ha

Indigenous Flora: Prostrate kanuka, classed as „At Risk-Naturally Uncommon’ (in de Lange *et al.* 2009) was at the site in 2000 (Beadel & Bill 2000), however it was not found in the 2004 survey.

Fauna: Common indigenous and introduced bird species typical of the habitat are present including fantail, harrier and pukeko.

¹ Previously identified as U17/18 in Wildland Consultants (2004).

**Current Condition
(2004 Assessment):**

Overall this site is in good condition. It is well buffered with indigenous vegetation and there are few weeds¹. However, the site is small in size and has a long history of disturbance from fire, cattle grazing, and drainage channel development (see Unpublished Atiamuri PNAP data 1995). The site is now fenced, so grazing is no longer a threat.

**Threats/Modification/
Vulnerability:**

*Invasive pest plants
(2004 Assessment):*

Blackberry (6-25% cover) poses the greatest threat to margins of the site and, if left uncontrolled, is likely to spread into the manuka-mingimingi shrubland areas.

*Human impacts
(2004 Assessment):*

The site is vulnerable to the further development of drainage channels on neighbouring farmland which would further lower the water table and alter ground temperatures. Damage to the vegetation also occurs from recreational use (e.g. trampling of geothermal vegetation and features during duck shooting season).

*Grazing
(2004 Assessment):*

Apart from the narrow strip of manuka shrubland alongside drains, the site is fenced to exclude stock. Along the edges of the drains with geothermal water there is some manuka die-back corresponding with bank erosion, which tends to occur where cattle can access the drain.

*Adjoining land use
(2004 Assessment):*

Farmland.

Site Change:

Recent change:

Based on aerial photographs, the site appears similar to the 2004 study.

Historical:

It appears that the surrounding land use (farming) has intensified since 1941 (Historical photos: SN 172 Run 1162 Photos 5-6, 1941). It also appears that the site was unfenced in 1941 and stock had access to the site. The size of the site has been approximately halved since 1941, with what is likely to have been geothermal wetland, having been converted to pasture, and drained. Some of the raw-soilfield vegetation to the south of the site has been converted to pasture. The area of manuka scrub is over twice the size of the current area, based on 2007 aerial photographs. Almost all change to this site is as a result of land drainage and development into pasture.

**Management
Requirements:**

Blackberry, if left uncontrolled is likely to spread into surrounding manuka and mingimingi dominated shrubland and further spread of blackberry should be prevented. Drainage (by adjacent farm drains) may be a key issue for managing blackberry at this site, as lowered water levels provide sites for blackberry to establish. No further drainage channels should be created and the margins of the heated creeks/channels need to remain fenced to exclude grazing animals. Trampling of vegetation and geothermal features should be kept to a minimum. Fences should be checked regularly and maintained.

Significance Level:

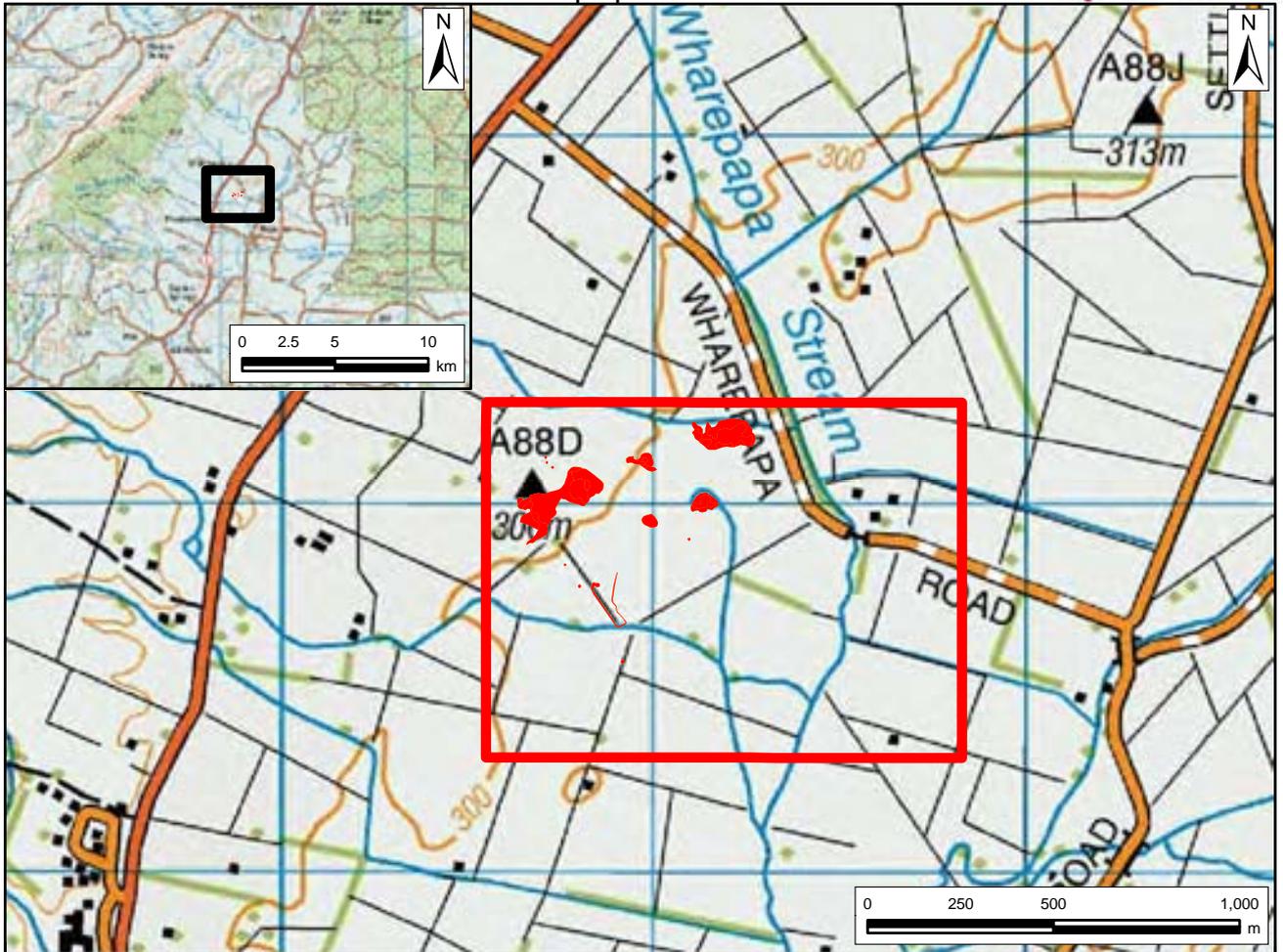
Regional (Table 1 - Criteria 1, 3, 5; Table 2 - Factor 10).

¹ Apart from in the narrow band of manuka shrubland outside the protected area.

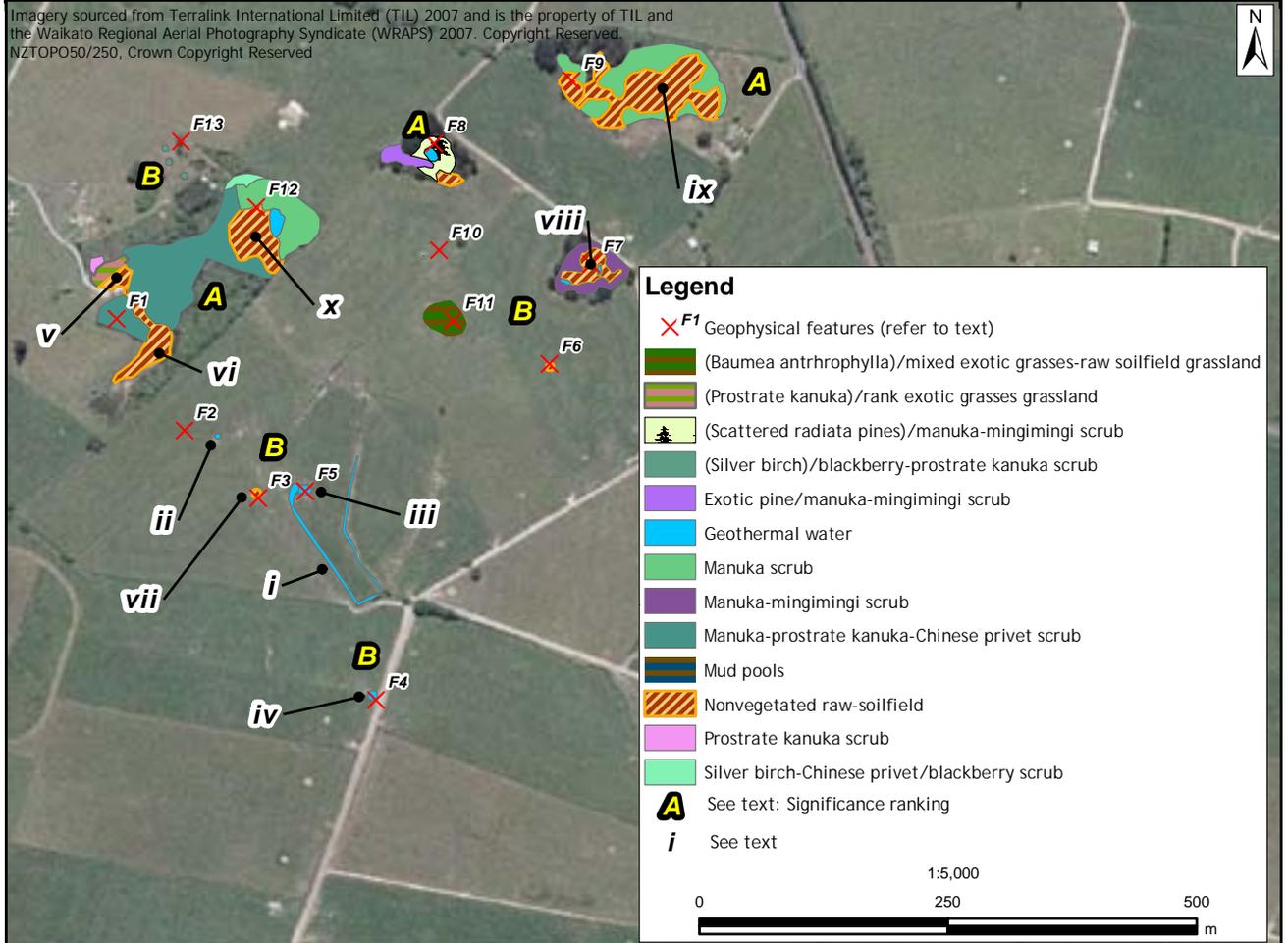
Significance Justification: This site is of regional significance because it is protected by a conservation covenant. It is the best example of geothermal vegetation associated with the Reporoa Geothermal Field.

Notes: Given (1996) assessed the botanical value of many of the geothermal sites in the Waikato Region and in this study, this site was classed as Category C - the third category.

References: Beadel & Bill 2000; Given 1995 & 1996; Unpublished Atiamuri PNAP data 1995; Wildland Consultants 2004.



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WHAREPAPA ROAD

Site Number: RPV02¹
Grid Reference: NZTopo50 BF37 907 430
GPS reference: NZTM E1890738 N5743011
Local Authority: Rotorua
Ecological District: Atiamuri
Geothermal Field: Reporoa
Bioclimatic Zone: Lowland - Submontane
Tenure: Unprotected private land
Altitude: c.300 m
Extent of Geothermal Habitat: c.3.5 ha
Extent of Geothermal Vegetation: c.3.3 ha
Date of Field Survey: 30 July 2010

VEGETATION		LANDFORM	EXTENT
CODE	TYPE		
04.01 04.01.01	Prostrate kanuka-dominant scrub Prostrate kanuka scrub A small area of prostrate kanuka scrub to 3 m tall. Occasional blackberry, Mercer grass, Chinese privet seedlings, and sheep's sorrel in understorey.	Gentle slope	<0.1 ha
04.03 04.03.01	Manuka-dominant scrub Manuka scrub Manuka-dominant scrub (1-4 m tall) surrounds geothermal features. Scattered blackberry is present. Occasional prostrate kanuka shrub.	Flat	c.0.8 ha
04.03 04.03.02	Manuka-dominant scrub Manuka-mingimingi scrub Manuka to 4 m tall is present, with patches of mingimingi-bracken scrub. Radiata pine surrounds the site. Several trees have been felled into the site.	Flat	c.0.1 ha
04.03.13	Manuka dominant scrub (Exotic pine)/manuka-mingimingi scrub Radiata pine is emergent over mixed manuka-mingimingi scrub with a canopy height of 2-5 m.		<0.1 ha
04.03 04.03.15	Manuka-dominant scrub (Scattered radiata pine)-manuka-mingimingi scrub Scattered radiata pines over manuka (to 4 m) and mingimingi scrub, with occasional prostrate kanuka present. Several oaks (<i>Quercus</i> sp.) and silver birch on margins.	Crater walls/flat	c.0.1 ha
04.03 04.03.17	Manuka-dominant scrub Manuka-prostrate kanuka-Chinese privet scrub Manuka, prostrate kanuka, and Chinese privet scrub to 7 m tall. Open areas dominated by mingimingi. Common understorey species include Yorkshire fog, Himalayan honeysuckle, blackberry, Chinese privet seedlings, and <i>Cotoneaster simonsii</i> .	Flat	c.0.9 ha
04.08 04.08.03	Blackberry-dominant scrub Silver birch-Chinese privet/blackberry scrub	Flat/ gently rolling	<0.1 ha

¹ Previously identified as U17/32 in Wildland Consultants (2004).

VEGETATION		LANDFORM	EXTENT
CODE	TYPE		
	Chinese privet and silver birch are emergent over blackberry scrub. Scattered broom present. Browntop and Yorkshire fog present in understorey.		
04.08 04.08.05	Blackberry-dominant scrub (Silver birch)/blackberry-prostrate kanuka scrub Occasional silver birch emergent over blackberry scrub, with scattered patches of prostrate kanuka. Fumaroles and small mud pools present.	flat	<0.1 ha
08.06 08.06.04	Mixed exotic-dominated grassland (Prostrate kanuka)/rank exotic grasses grassland Occasional prostrate kanuka over mixed exotic grassland species, including Indian doab, wild seradella (<i>Ornithopus perpusillus</i>), hawksbeard, browntop, Mercer grass, catsear, and lotus). Soil temperature was 15°C at 5 cm depth on winter morning.	flat	<0.1 ha
08.06 08.06.05	Mixed exotic-dominated grassland (Baumea arthropphylla)/mixed exotic grasses-raw-soilfield grassland Emergent <i>Baumea arthropphylla</i> is present over rank exotic grassland species, including browntop, catsear, white clover, <i>Gonocarpus micranthus</i> , sheep's sorrel, and sweet vernal. Approximately 25 × 50 m of geothermal activity, including fumaroles, mud pools, and heated bare soils. Scattered pumice rocks were common.	Gently sloping/ Flat	c.0.1 ha
22.01 22.01.01	Geothermal water Geothermal water (i) Geothermal water in drain, surrounded by exotic grasses, including reed sweet grass, Yorkshire fog, and <i>Rumex crispus</i> . Mosquitofish were recorded in drains. (ii) Hot pool. (iii) Geothermal pool surrounded by mossfield. <i>Gonocarpus micranthus</i> on margins. Spring is surrounded by pasture grasses. (iv) Geothermal spring in ditch surrounded by rank grassland species, particularly reed sweetgrass and Yorkshire fog. The temperature was c.47°C with green and orange algae present near spring outflow and drainage channel.	Open water	c.0.2 ha
22.01 22.01.02	Geothermal water Mud pool A mud pool surrounded by sheep's sorrel and grazed pasture grasses. Wood has been thrown into the mud pool.	Open water	<0.1 ha
28.01 28.01.01	Nonvegetated raw-soilfield Nonvegetated raw-soilfield (v) Sinter terrace, hot pools, occasional prostrate kanuka, occasional manuka. Scattered patches of Indian doab and hawsbeard. (vi) Patches of arrow grass on sediments from geothermal springs. Overflow from geothermal springs, 7°C during field survey.	Flat	c.1.2 ha

VEGETATION		LANDFORM	EXTENT
CODE	TYPE		
	(vii) Steaming ground. Five fumaroles. Occasional sheep's sorrel, Yorkshire fog, and annual poa (<i>Poa annua</i>). Small patch of sinter present.		
	(viii) Occasional mingimingi on margins. Scattered oaks and silver birch overhanging.		
	(ix) Nonvegetated raw-soilfield, including a mud pool. Downstream of mud pool, scattered arrow grass, Yorkshire fog, and <i>Baumea arthrophylla</i> on overflow margins.		
	(x) Bare ground, geothermal water. Occasional prostrate kanuka to 3 m tall, manuka seedlings, arrow grass, <i>Lachnagrostis</i> sp.		

Geophysical Assessment:¹

Feature 1: Hot Clear Pool, Sinter Terrace (labelled as F1 on feature map).

This feature is a hot clear pool with a slight blue colouration. The temperature of the water was 90°C and the pH was 8.6. The pool measures approximately 4 m² and has two central fissures/chambers at least 1 m deep and approximately 0.5 m in diameter. The remaining area of the pool is shallow, 5-10 cm. Only one of the chambers appeared to be supplying fluid to the pool. There are at least three relic drainage channels from the pool and it is surrounded by a large 25 m² sinter terrace. Two constructed channels now drain the outflow from the pool and as such the sinter terrace is no longer being deposited. The water level is 5-6 cm below the sinter apron. Both the sinter apron and discharge channels exhibit minor sulphur encrustation. The main man-made channel was measured to calculate the discharge. The flow from the pool was calculated to be approximately 0.9L/sec (based on a channel width of 0.15 m, depth of 0.03 m and a velocity of 0.2 m/sec). A second small up-welling of fluid was noted in one of the relic drainage channels (Plate 75). It had a temperature of 90°C and flow of approximately 0.1L/sec.

The constructed channel directs the pool outflow to a series of baths after which the outflow meets the original sinter terrace formed by the pool which was deposited down a gentle slope to the southeast. The sinter terrace is extensive and measures 70 × 30 m, however the area of active deposition is small, near the bathing water discharge point (Plate 76). The vast majority of the terrace is deteriorating, and at its lowest point is covered by a layer of silt which makes the sinter structure barely visible (Plates 77 and 78). At this point the sinter is very brittle. A field sketch has been prepared of the pool and sinter terrace area.

¹ Geophysical assessment undertaken by Julian McDowell and reviewed by Juliet Newson, 2010.



Plate 74: Hot Clear Pool, sinter apron and terrace. Note two main chambers and discharge channels at Feature 1, Wharepapa Road.



Plate 75: View of Small upflow, sinter terrace, main pool and baths in background at Feature 1, Wharepapa Road.



Plate 76: Relic Sinter Terrace looking north towards baths. Active sinter deposition area out of sight in left hand corner at Feature 1, Wharepapa Road.



Plates 77 and 78: Deteriorating Sinter Terrace. Structure still visible but very brittle/soft underfoot at Feature 1, Wharepapa Road.

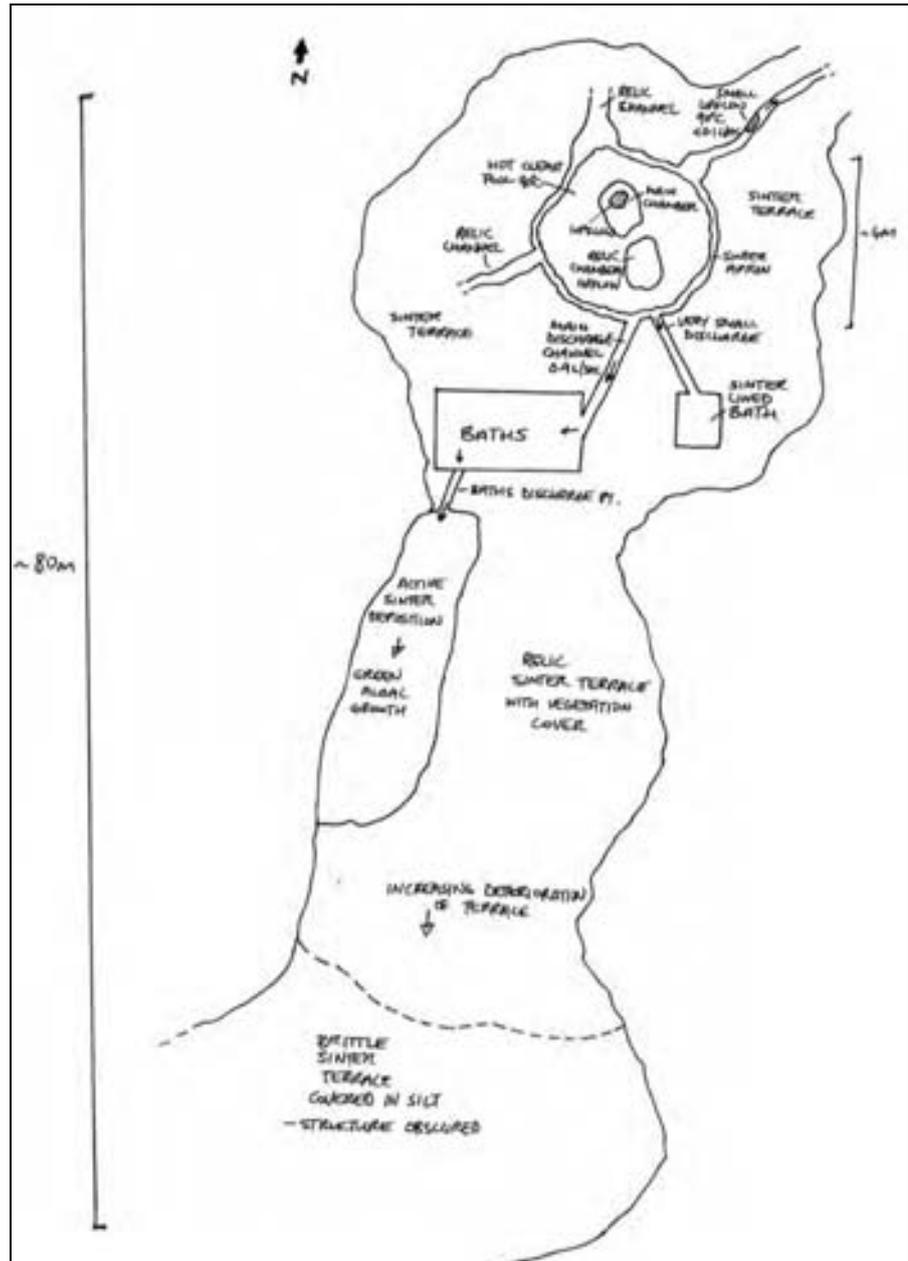


Figure A1-21: Field sketch map of hot pool, drainage and sinter terraces at Feature 1, Wharepapa Road.

Feature 2: Hot Clear Pool (labelled as F2 on site map)
Grid Reference: E1890775 N5742844

This feature is a hot clear pool with a dark grey base (Plate 79). There is evidence of a sinter apron around the pool, although it is weathered and is coated in dark grey soil. The pool is approximately 3 m long and has two main chambers, one of which was bubbling. The temperature of the water was 90°C while the pH was a neutral 7.6. There was no discharge from the pool at the time of the visit but a damp discharge channel does exist to the southeast of the pool. The soil temperatures surrounding the pool ranged from 12°C to 47°C, the highest point being within the channel. Adjacent to the pool are two outcrops of silicified pumice rock which appeared to have some sinter structure (Plate 80). They are both weathered and fractured.



Plate 79: Hot Clear Pool with damp discharge channel at Feature 2, Wharepapa Road.



Plate 80: Silicified Pumice outcrop to the east of pool at Feature 2, Wharepapa Road.

Feature 3: Steaming ground, Fumaroles (labelled as F3 on feature map) Grid Reference: E1890799 N5742775

There is an area of steaming ground comprising five fumaroles, four of which are roughly in alignment along a NW/SE orientation (Plate 81). The vents are too deep to see the base, however there was audible bubbling and the thermocouple device was used to measure a temperature of 95°C in one of them. The area is approximately 10 × 3 m. The largest of the fumaroles appeared to be a discharging feature in the past (either mud or water) as a discharge area with flow patterns was identified near the opening (Plate 82).

In the area surrounding the fumaroles there is relic deteriorated sinter terrace and a sinter bank. It would appear that the features at this location discharged sinter depositing fluid in the past.



Plate 81: Line of 4 Fumaroles in NW/SE orientation with silicified bank behind and deteriorating terrace in front, Feature 3, Wharepapa Road.



Plate 82: Large fumarole with relic sinter terrace and relic flow/drainage formations at opening (arrow), Feature 3, Wharepapa Road.

Feature 4: Thermal Spring (labelled F4 on feature map)
Grid Reference: E1890917 N5742571

A large pool within a ditch at the edge of a culvert had a steam discharge and temperature of 47°C. There was no obvious upflow but the discharge from the pool was estimated to be approximately 1.5L/sec. There was abundant green and orange algal growth along the discharge channel.



Plate 83: Hot Spring/Pool. Note orange and green algae in discharge channel, Feature 4, Wharepapa Road.

Feature 5: Hot Clear Pool (labelled F5 on feature map)
Grid Reference: E1890856 N5742786

This feature is a large 5 m² clear pool. The water has a blue colouration (colloidal silica) and is at boiling point (99°C using thermocouple). The pH of the water is 7.8. It is at least 2 m deep and is discharging via a discharge channel (Plate 84). The pool itself has a small/narrow sinter apron with grass meeting its margins while there is active silica deposition along the discharge channel and ditch (Plate 85). Both the discharge channel and silicified ditch appear to be manmade and direct the outflow into a stream to the south. At the point where the ditch meets the stream the temperature is 78°C and there is no further silica deposition (Plate 86). The discharge channel from the pool has a section measuring 1 m which made the flow estimation very straightforward, approximately 4.5L/sec. The point where

the channel meets the ditch could provide a good location to install a weir for future flow recording.

To the east of the pool and sinter ditch there is another minor stream draining the land (Plate 87). There are numerous hot spring inputs into this stream ranging from 45°C to 60°C. The temperature of the minor stream is 24°C before it also meets the main stream to the south. A schematic of the drainage system including the pool discharge, minor stream and main stream is presented below showing flow rates and temperatures at various points.



Plate 84: Hot Clear Blue pool with discharge channel in background, Feature 5, Wharepapa Road.



Plate 85: Pool discharge channel joining ditch - both have considerable silica deposition, Feature 5, Wharepapa Road.



Plate 86: Pool discharge meeting main stream. Note minimal sinter deposition at this point (78°C), Feature 5, Wharepapa Road.



Plate 87: Minor stream with hot spring inputs, Feature 5, Wharepapa Road.

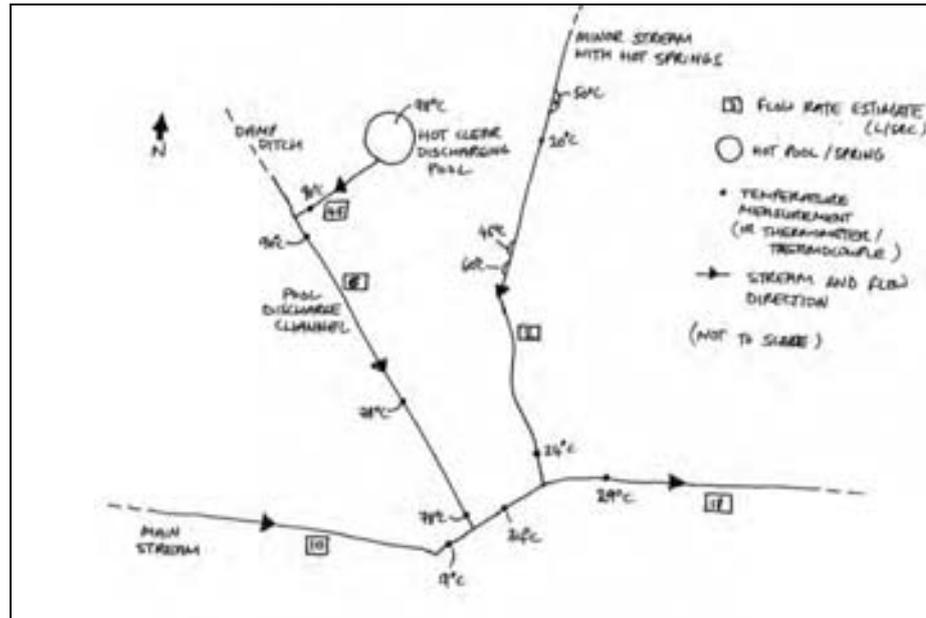


Figure A1-22: Schematic of hot pool drainage, temperature and local stream inputs, Feature 5, Wharepapa Road.

Feature 6: Mud Pool (labelled F6 on feature map)
 Grid Reference: E1891092 N5742911

This feature is a small boiling mud pool which measures 1.5 m² and is approximately 1 m deep. The temperature of the fluid was 99°C. At the edge of the pool there is evidence of relic sinter deposition (Plate 89), indicating historical silica laden fluid discharge in the past. Broken timber was at the base of the pool and at its edge.



Plate 88: Mud pool, Feature 6, Wharepapa Road.



Plate 89: Sinter structure at edge of mud pool, Feature 6, Wharepapa Road.

Feature 7: Exposed ground, Fumaroles, Mud pools (labelled as F7 on feature map)

Grid Reference: E1891134 N5743013

A large area of exposed ground with active fumaroles and mud pools lies 100 m to the northeast of the mud pool (Feature 34). The area measures approximately 25×50 m. Access to take *in situ* measurements was not deemed safe at this area. As such only the largest of the mud pools was measured using the IR thermometer and returned a temperature of 72°C (Plate 90). A field sketch indicating the location and type of features is shown below. The location has four other large mud pool areas as well as many small pools and a pit consisting of multiple fumaroles (Plate 91). There is an isolated area of geothermal type vegetation in the centre of the area around which soil temperatures ranged from 13°C to 53°C at 10 cm depth. There were no outflows noted from any of the features.



Plate 90: Large Mud pool, 72°C at surface, Feature 7, Wharepapa Road.



Plate 91: Mud pit with multiple fumaroles discharging steam, Feature 7, Wharepapa Road.

Feature 9: Exposed ground, Hot Clear Pool, Mud pools (labelled F9 on feature map)

Grid Reference: E1891114 N5743198

The western part of this area was mapped, while the eastern area was not accessible. The western area comprised an area of exposed ground with steaming ground, at least two mud pools, and one hot clear green/blue pool.

The clear pool was approximately 1.5×3 m and appeared to be at least 2.5 m deep. The water had a green/blue colouration (colloidal silica), a temperature of 80-85°C and a pH of 8.7. A sinter apron was well formed at its edge and along its discharge channel. The discharge flowed to the east and was estimated to be approximately 1L/sec. A wooden palette and bird feathers nearby indicated that this pool is used by local famers for cooking or game hunting related purposes.

Two metres to the west of the clear pool is a 2 m^2 mud pool with a temperature of 85°C and two fumaroles with audible boiling/bubbling beneath the surface. It is thought that these are also mud pools.

A view through the vegetation into the eastern part of the area indicated an expanse of exposed ground and multiple mud pools and fumaroles.



Plate 93: Hot clear green/blue pool. Note wooden palette access point to pool and sinter apron, Feature 9, Wharepapa Road.

Feature 10: Fumaroles, Mud pools (labelled F10 on feature map)

Grid Reference: E1890981 N5743026

At this location there are two small fumaroles 0.3 m^2 with audible bubbling at depth and two mud pools with surface temperatures of 85°C and 51°C. Near the pools were two outcrops of silicified pumiceous rock.

Feature 11: Fumaroles, Mud pools (labelled F11 on feature map)
Grid Reference: E1890995 N5742955

Forty metres to the south of Feature 10 is a larger area (25 × 50 m) of small mud pools, steaming ground and fumaroles. The temperatures in the mud pools ranged from 30°C to 90°C. Amongst the mud pools are large areas of silicified pumiceous rock outcrop. The largest mud pool has a temperature of 35°C and measured 3 × 5 m.



Plate 94: Area of mud pools, fumaroles and silicified outcrop, Feature 11, Wharepapa Road.

Feature 12: Hot clear pools, Sinter terrace (labelled F12 on feature map)
Grid Reference: E1890797 N5743070

This feature comprises an extensive sinter terrace measuring approximately 50 × 75 m with numerous small clear hot pools and one large boiling pool.

At the highest point of the terrace at the northern limit there is a large 10 × 2 m boiling clear blue pool (Plate 95). Two main upwelling/boiling areas were noted in the pool. The temperature reading on the IR thermometer was 110°C while the thermocouple measured 100°C; the pH of the pool was 7.3. The boiling areas were vigorous and the steam discharge from the pool was considerable. The discharge from the pool was diffuse from a number of channels and as such was estimated to be in the order of 4-5L/sec. The depth of the pool appeared to be at least 2-3 m. The sinter apron had sulphur deposition in places.

Numerous other shallow pools were observed at the location with temperatures ranging from 27°C at the southern limit of the terrace to 80°C approximately 5 m from the large boiling pool. The water level was very shallow across the terrace and there was considerable silt deposition across the southern half of the area. The discharge stream which forms beyond the lowest point of the terrace had a temperature of 22°C and a flow of roughly 2 L/sec.

A field sketch has been prepared indicating the main features at this location (A1-24).



Plate 95: Boiling Clear Pool. View of most vigorously boiling area. Note sulphur deposition on edge, Feature 12, Wharepapa Road.



Plate 96: View of sinter terrace looking north to boiling pool (steaming area in background). Note shallow water level and silt deposition in foreground, Feature 12, Wharepapa Road.



Plate 97: Southern limit of terrace. Note dark sinter bank and small stream collecting the terrace run-off, Feature 12, Wharepapa Road.

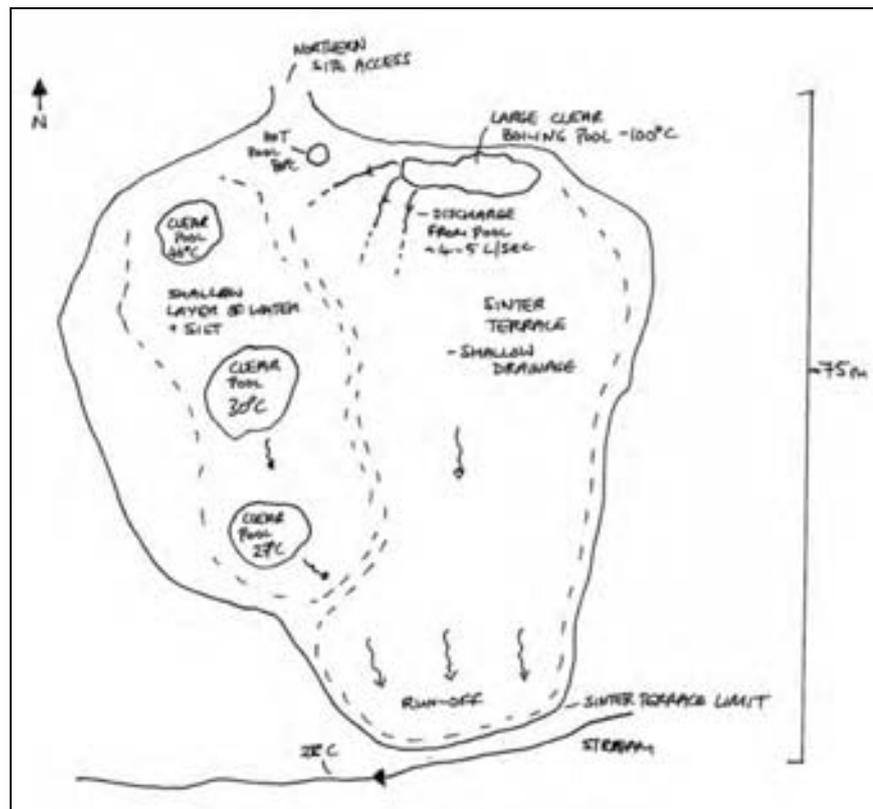


Figure A1-24: Field Sketch of Boiling Pool/Sinter Terrace, Feature 12, Wharepapa Road.

Feature 13: Mud pools (labelled F13 on feature map)
Grid Reference: E1891134 N5743013

There are two mud pools at this location measuring 2 m² each. The temperatures ranged from 58-60°C. There was also refuse and tree branches in the pools.



Plate 98: Mud pool with refuse, Feature 13, Wharepapa Road.

Indigenous Flora:

Small populations of both prostrate kanuka (classed as „At Risk-Naturally Uncommon’ in de Lange *et al.* 2009) and *Campylopus* sp. occur here. Both are endemic species restricted to geothermal areas. An interesting population of *Baumea arthropphylla* is present. Other species characteristic of geothermal habitat include mingimingi, manuka, and *Histiopteris incisa*.

Fauna:

Common indigenous and introduced bird species typical of the habitats are likely to be present, including Australasian harrier, spur-winged plover, grey warbler, Australasian magpie, pukeko, fantail, house sparrow, blackbird, goldfinch, welcome swallow, and skylark. Pied stilt classed as „At Risk-Declining’ in Miskelly *et al.* (2008) use the habitats present. Mosquitofish were recorded in drains.

Current Condition (2010 Assessment):

These small and isolated areas surrounded by farmland are in poor condition; highly modified by dairy farming and the dumping of rubbish. A number of sites are fenced to exclude stock and have geological features of high significance. Pest plants are common, but the site is good potential habitat for indigenous geothermal plants.

**Threats/Modification/
Vulnerability:**

Invasive pest plants (2010 Assessment):

Several exotic species occur in each of these areas and are likely to continue to increase in extent under current management. Key weed species present are rank pasture grasses (26-50% cover), *Cotoneaster simonsii* (1-5% cover), blackberry (6-25% cover), oaks (1-5% cover), silver birch (1-5% cover), *Pinus* spp. (including radiata pine, maritime pine, lodgepole pine)

(5-25% cover). Silver birch and pines could damage geothermal features if they fall into them.

*Human impacts
(2010 Assessment):*

Rubbish disposal is the main human-related threat to these areas. Rubbish, which includes litter, fencing material, white-ware and garden refuse, is dumped on the sinter terraces. Several drainage channels from the hot pools extend across the farmland, and these lower the water table and alter ground temperatures (Unpublished Atiamuri PNAP data 1995). Several geothermal baths are present at the site. Until recently, this pool was also used by pig hunters to clean their pigs. Harvesting of trees has caused considerable damage to geothermal features at one location. Many features are threatened by farming activities (see below).

*Grazing
(2010 Assessment):*

Most of the areas are currently fenced but the fences are poor in places, allowing livestock access.

*Adjoining land use
(2010 Assessment):*

Farmland, shrubland.

Site Change:

Recent change:

More features were found in the 2010 survey than earlier surveys; however these would have been present in earlier surveys.

Historical:

Historical photos of the site from 1941 were studied to assess long-term change at this site (Historical photos: SN 172 Run 1162 Photos 2-3, 1941). The development of farmland around these geothermal sites was less intense in 1941, with shrubland linking most of the features together. The geothermal activity to the north-east of the site appears to have become more active. The area of mud pools and bare ground appears to be shrubland in 1941, and the area of bare ground is about five times the size it was in 1941. The large unit to the south-west of the site has considerably more bare ground. Because of conversion to pasture, and taking into account shrubland masking geothermal surface features in the 1941 photographs, the best estimate is that geothermal habitat in 1941 would have been about three times larger than that currently present (and mapped) at Wharepapa Road.

**Management
Requirements:**

Stock access to some areas and dumping of rubbish should be prevented. Planting of exotic species around geothermal features should be discontinued, and the impacts of the drainage channels should be monitored. Consideration should be given to fencing to exclude stock from all geothermal features within this site. Pest plants (particularly trees that could fall into features) should be controlled.

Significance Level:

A: Regional (Table 1 - Criteria 3, 5; Table 2 - Factor 14)
B: Local (Table 1 - Criterion 5; Table 2 - Factor 19)

**Significance
Justification:**

This site has been divided into two parts, A and B (see site map).

A: These areas are of regional significance because, when considered together, they form a moderate-sized area of a nationally uncommon habitat type. They contain small populations of an „At Risk’ species (prostrate kanuka).

B: These areas are of local significance because they contain small, disjoint, degraded examples of a nationally uncommon habitat type (geothermal).

Notes:

Given (1996) assessed the botanical value of many of the geothermal sites in the Waikato Region, and in this study this site was classed as Category B - the second highest category.

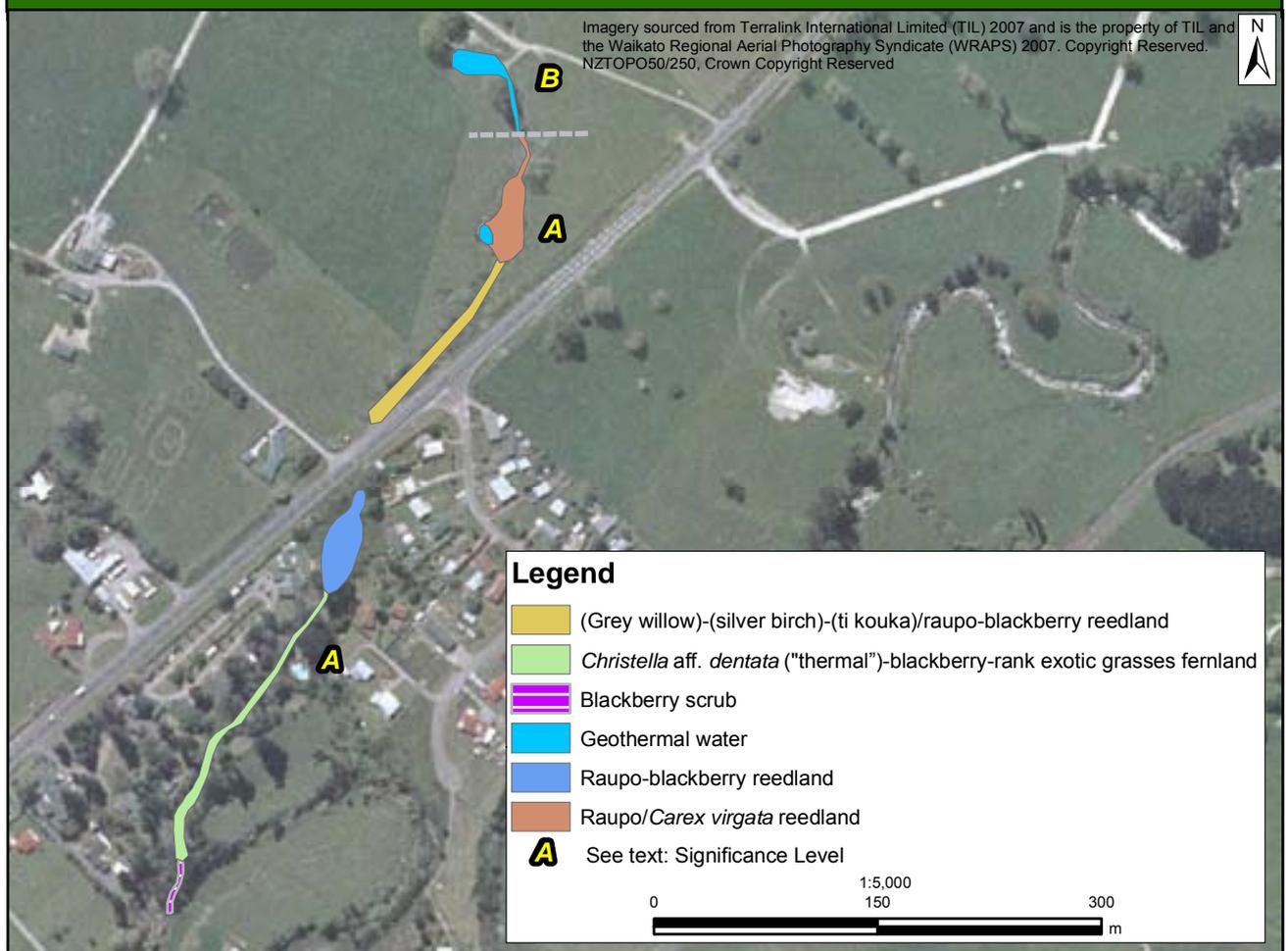
Features 2 and 12 are also listed in Waikato Regional Council (unpublished) as “South (SE) Spring” and “Opaheke Spring” respectively.

References:

Beadel & Bill 2000; Given 1995 & 1996; Unpublished Atiamuri PNAP data 1995; Waikato Regional Council (unpublished); Wildland Consultants 2004.



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Legend

- (Grey willow)-(silver birch)-(ti kouka)/raupo-blackberry reedland
- Christella* aff. *dentata* ("thermal")-blackberry-rank exotic grasses fernland
- Blackberry scrub
- Geothermal water
- Raupo-blackberry reedland
- Raupo/*Carex virgata* reedland
- A See text: Significance Level

0 150 300
1:5,000
m

GOLDEN SPRINGS

Site Number: RPV03¹
Grid Reference: NZTopo50 BF37 889 372
GPS Reference: NZTM E1888850 N5737187
Local Authority: Rotorua
Ecological District: Atiamuri
Geothermal Field: Reporoa
Bioclimatic Zone: Lowland
Tenure: Unprotected private land
Altitude: 300 m
Extent of Geothermal Habitat: c.0.5 ha
Extent of Geothermal Vegetation: c.0.4 ha
Date of Field Survey: 14 May 2007

Code	Type	Landform	Extent
04.08 04.08.01	Blackberry-dominant scrub Blackberry scrub Stream margins are dominated by blackberry scrub with scattered <i>Christella</i> aff. <i>dentata</i> (“thermal”). Kanuka is common in the canopy.	Stream margins	<0.1 ha
07.06 07.06.02	<i>Christella</i> aff. <i>dentata</i> (“thermal”)-dominant fernland <i>Christella</i> aff. <i>dentata</i> (“thermal”)-blackberry-rank exotic grasses fernland A narrow band along stream margins, where steam from the geothermal stream that flows past Golden Springs camping ground creates suitable habitat for <i>Christella</i> aff. <i>dentata</i> (“thermal”). Scattered, planted, ornamental garden plant species are common in places. Other common species present include sweet vernal, annual poa, white clover, black nightshade, fleabane, scotch thistle, agapanthus (<i>Agapanthus praecox</i>), Spanish heath, ivy, Japanese honeysuckle, Chinese privet, <i>Cyperus ustulatus</i> , arrow bamboo, <i>Carex secta</i> , <i>Carex virgata</i> , blackberry, <i>Deparia petersenii</i> , <i>Histiopteris incisa</i> , shaking brake (<i>Pteris tremula</i>), kiokio, swamp kiokio, and bracken. Blackberry scrub becomes dominant in this type at the south end of the site. Several prostrate kanuka plants are present. The stream has been extensively altered in places with a diversion for water wheels, and channels have also been dug. A concrete structure is present at the northern end of the block.	Stream margins	c.0.1 ha
11.01 11.01.09	Raupo-dominant reedland Raupo/<i>Carex virgata</i> reedland A small geothermal wetland dominated by raupo with common patches of <i>Carex virgata</i> , <i>Carex secta</i> , and <i>Hypolepis ambigua</i> . Blackberry is common on the margins and there are occasional grey willows.	Wetland	c.0.1 ha
11.01 11.01.10	Raupo-dominant reedland (Grey willow)-(silver birch)-(ti kouka)/raupo-blackberry reedland A raupo and blackberry-dominated geothermal drain alongside	Roadside drain	c.0.1 ha

¹ Previously identified as U17/27 in Wildlands (2004 and 2007b).

Code	Type	Landform	Extent
	State Highway 5. Emergent grey willow, silver birch, ti kouka, and wheki are common. Plants of <i>Christella</i> aff. <i>dentata</i> (“thermal”) are present at the south end of the drain. Other common species include Chinese privet, kiokio, and <i>Carex virgata</i> .		
11.01 11.01.11	Raupo-dominant reedland Raupo-blackberry reedland A small geothermal wetland dominated by raupo with blackberry common in dry parts. Other species present include <i>Carex virgata</i> .	Wetland	c.0.1 ha
22.01 22.01.01	Geothermal water Geothermal water Geothermal hot springs and open water habitats surrounded by exotic pasture species. Common species on the margins include sweet vernal, <i>Eleocharis acuta</i> , <i>Paesia scaberula</i> , Mercer grass, <i>Schoenoplectus tabernaemontani</i> , creeping buttercup, fleabane, water purslane and blackberry.	Open water	0.1 ha

Indigenous Flora: *Christella* aff. *dentata* (“thermal”) (classed as „At Risk-Declining’ in de Lange *et al.* 2009) is scattered along stream margins throughout this site.

A few scattered prostrate kanuka (classed as „At Risk-Naturally Uncommon’ in de Lange *et al.* 2009) are present. Prostrate kanuka is endemic to geothermal habitat in New Zealand.

Fauna: North Island fantail, bellbird, spur-winged plover, blackbird and pukeko were recorded. Other common indigenous and introduced bird species typical of the habitat are likely to be present.

Current Condition (2007 Assessment): This site is generally in a poor ecological condition. The part of the site on the western side of the road is mostly unfenced and accessible to stock. The parts on the eastern side of the road are within a camping ground and their condition is directly affected by management of recreational activities. The downstream (southern) end of the site is overrun with blackberry. Exotic plantings are common along the length of the stream.

**Threats/Modification/
Vulnerability:**

Invasive pest plants (2007 Assessment): Blackberry (5-25% cover), Chinese privet (1-5% cover), grey willow (1-5% cover), Japanese honeysuckle (1-5% cover), and ivy (1-5% cover).

Human impacts (2007 Assessment): Part of the site is farmed. The rest is negatively impacted by stream management including concreted stream sections, water wheels, exotic plantings, and mowing close to stream margins.

Grazing (2007 Assessment): Stock have access to most geothermal features on the western side of State Highway 5.

Adjoining land use (2007 Assessment): Farmland, camping ground, state highway, residential.

Site Change:

Recent change: Not assessed. Any significant change is unlikely.

Historical: This site is too small for any evidence of change to be identified on aerial photographs (Historical photos: SN 172 Run 1165 Photos 3-4, 1941).

Management Requirements:

The fences should be maintained at the site and stock should be excluded from geothermal areas. Management options should be discussed with land managers to maintain populations of the threatened *Christella* aff. *dentata* (“thermal”). Fencing of the site is likely to result in an increased area of suitable habitat for this species, which is susceptible to grazing. There are significant opportunities for ecological restoration around stream margins, in areas of open geothermal water, and within geothermal wetlands.

Significance Level: This site has been divided into two parts for ranking - A and B.

A: Regional (Table 1 - Criterion 3, 5, 9; Table 2 - Factor 12).

B: Local (Table 1 - Criterion 5; Table 2 - Factor 19)

Significance Justification:

A: This part of the site is of regional significance as it is an important site for the conservation of an „At Risk’ species - *Christella* aff. *dentata* (“thermal”). Bycroft & Beadel (2007c) estimated that there were 45 mature plants present at this site in 2007. This species is only known from 14 sites in the North Island, and many populations are threatened by grazing, human induced changes to geothermal fields (e.g. energy production), and vegetation clearance. It has become extinct at four sites.

B: This part of the site is of local significance because it contains geothermal habitat - a nationally uncommon habitat.

Notes:

Given (1996) assessed the botanical value of many of the geothermal sites in the Waikato Region, and in this study this site was classed as Category B - the second highest category. Area A of this site was ranked as being of National importance in Wildland Consultants (2007b), due to the presence of *Christella* aff. *dentata* (“thermal”) which was then classified as „Chronically Threatened’. However the threat status of this species was downgraded in de Lange *et al.* (2009) and the site ranking has consequently been changed to Regional significance in this study.

References:

Beadel & Bill 2000; Bycroft & Beadel 2007c; Given 1989, 1995 & 1996; Unpublished Atiamuri PNAP data 1995; Wildland Consultants 2004, 2007b & 2007c.

